IoT Project 2025

Only t**wo** options are available for the implementation of the IoT project:

- **Solo project**
- **Group project**: each group must be composed of 2 students.

No other options are available.

The project **must** be discussed in the **same exam session** in which the oral part of the exam will be given.
In the case of group project, the project can be discussed only if at least one of the two members will give the oral part of the exam in the current session.

Project Objective

The goal of the project is to design and implement an IoT application. The use case must be selected by the student(s) among the following six domains, that aim at energy efficiency:

- **Smart Grid:** involving applications for monitoring, automation, and optimization of energy distribution and consumption.
- **Advanced Metering Infrastructure (AMI):** focusing on smart metering systems and bidirectional energy communication.
- **Renewable Energy Integration:** dealing with IoT solutions for managing solar, wind, and other renewable energy sources.
- **Demand Side Management (DSM):** including intelligent systems for load forecasting, peak shaving, and consumer energy behavior.
- **Electric Vehicles and Charging Infrastructure:** addressing energy exchange, smart charging, and V2G communication.
- **Smart Homes and Buildings:** enabling real-time control and energy efficiency in residential or commercial environments.

The adherence to one of the specified use case domains is a required element and will be part of the project evaluation.

To explore potential use cases, we recommend referring to the paper:“A. Asit Kumar Majhi and S. Mohanty, "A Comprehensive Review on Internet of Things Applications in Power Systems," in IEEE Internet of Things Journal” to take ideas on the use case.

The paper can be found as Teaching Material on the TEAMS channel of the course.

System scheme and structure

The system **must** comprise the following components:

- *A network* of IoT devices, including sensors collecting data from the physical system/ environment and actuators.

- The network must be deployed using real sensors (nrf52840 dongle). In the network a border router must be deployed in order to provide external access[1].

- The application-layer protocol adopted by the IoT devices **may be** MQTT, CoAP, or a combination of both. **The choice must be explicitly justified and documented** in the project documentation and **will be considered as part of the evaluation**. Devices using CoAP must implement both CoAP Server functionality, to expose their resources (e.g., sensors or actuators), and CoAP Client functionality for interacting with other devices or services.

- A machine learning model that runs on a subset, or all, of the IoT devices. The machine learning model aims at taking **autonomous decisions** on some of the functions of the use case **directly on the IoT device without requiring assistance from external applications**, e.g., by forecasting some metrics and making a decision, by highlighting anomalies and react to them, etc.
  The machine learning model must be trained accordingly to the procedure presented in class using some open datasets available on the internet, e.g., https://www.kaggle.com/. The colab workbook that is used to train the model must be downloaded and included in the project submission. The workbook must include also a reference to the dataset used.

- The *Cloud Application* collects data from MQTT or CoAP sensors, store them in a MySQL database.

- The *Remote control Application* reads information about actuators and sensors from the database and implements a simple *control logic* in order to apply some modifications to one or more actuators based on the data collected from the sensors, e.g. some closed-loop control logic.

- It is required to provide some User Input to implement the User logic for the IoT application. The User input can be implemented as a command line interface.

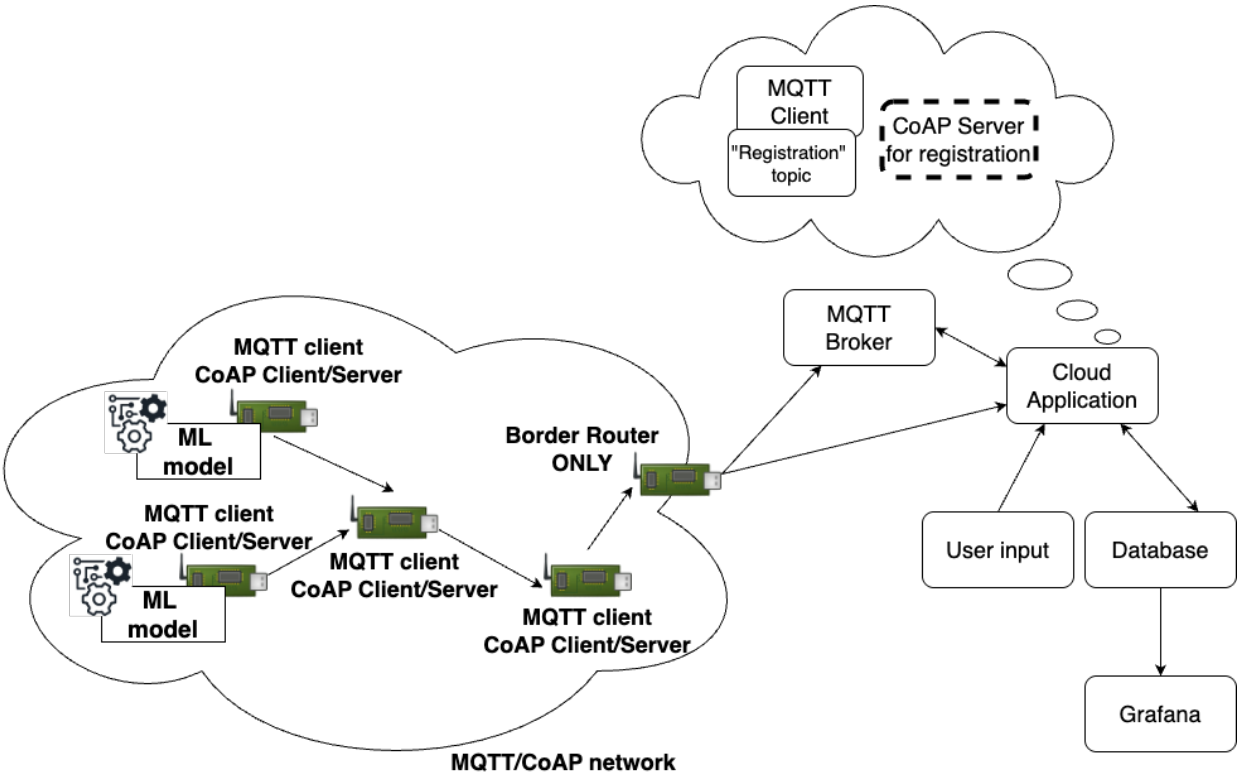
- **[GROUP PROJECT]** When using CoAP, the CoAP actuators and sensors must register to the Cloud Application, acting as a CoAP Client. This to create a directory of sensors and actuators in the Database. When using MQTT a “registration” topic must be created, to make the registered actuators and sensors available in the specific directory in the Database.

- **[SOLO PROJECT]** The list of actuators and sensors is statically created and exploited by the User Application via a configuration file.

- **[GROUP PROJECT]** A web-based interface deployed using Grafana must be developed in order to show the data collected and stored on the database.

[1] For the sake of simplicity, during the deployment we suggest to simulate the network on Cooja with (MQTT) and CoAP sensors.

System scheme



Guidelines/Requirements

- The application can be implemented using JAVA or Python
- Button **and** LED interactions with sensors **must** be used.
- Data should be encoded in a proper format that might depend on the specific use-case. The selection of the encoding language should be motivated, and it is going to be part of the evaluation.

Project submission

Projects must be submitted at least **4 days prior to the day of the exam,** e.g., if the exam session is the 06/06/2025 the last day for the submission (included) will be 02/06/2025.

The project must be submitted using this link: https://forms.gle/3CKJJfizFvP67b5s8. Students must submit the **code** of the project and a **document describing the implementation and the use-case**. For the latter both a report or a detailed presentation are accepted.

Project discussion

The project discussion will take place the day of the exam, in person.The discussion, 10 minutes max for SOLO PROJECT, 15 minutes max GROUP PROJECT, will consist on the demo of the execution of the application, showing all the implemented and required features (5/10 minutes), and on 5 minutes questions on the code.